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METHOD OF MANUFACTURING A SEALED ELECTRONIC MODULE

Technical Field

The present invention relates to the manufacture of a sealed electronic module including a circuit board/connector assembly and a housing open at one end.

Background of the Invention

In the manufacture of electronic modules, various electronic components are mounted on a printed circuit board, connector terminals are soldered to a marginal portion of the circuit board, and the assembly is packaged in a plastic or metal housing. Usually, some provision is made for affixing the circuit board to the inner periphery of the housing, and the housing closes around the circuit board, with the connector pins protruding through the housing to enable electrical signal transmission to and from the module. In applications where the module has to be environmentally sealed, it is desirable to minimize the length and number of sealing surfaces. Theoretically, the sealing surfaces can be minimized by forming the housing as a single part with one opening through which the circuit board/connector assembly is inserted, but such an approach makes it difficult to attach the circuit board to the inner periphery of the housing since the interior of the housing is inaccessible after insertion of the circuit board/connector assembly. Alternatively, the entire housing may be filled with a potting material such as epoxy, but that is undesirable for several reasons, including cost, weight and the inadvisability of coating certain electronic components with potting material. Accordingly, what is needed is an improved method of manufacturing a sealed electronic module where the enclosed circuit board is securely attached to the inner periphery of the housing.

Summary of the Invention

The present invention is directed to the manufacture of an electronic module including a circuit board/connector assembly and a housing that is open at one end, where potting material is used to mechanically secure the circuit board to the housing and to provide an environmental seal at the open end of the housing. The empty housing is positioned so that its open end is facing upward, and a first quantity of potting material is dispensed into the housing. The circuit board/connector assembly is then inserted into the housing, immersing the inboard end of the circuit board into the potting material. The connector includes a cover that conforms to the inner periphery of the housing, forming an annular pocket at the open end of the housing, and a second quantity of potting material is then dispensed into the annular pocket. When cured, the first quantity of potting material attaches the inboard end of the circuit board to the inner periphery of the housing, and the second quantity of potting material attaches the connector to the housing and environmentally seals the module.

Brief Description of the Drawings

The present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figures 1A-1D illustrate the manufacturing method of this invention. Figure 1A depicts a circuit board/connector assembly, Figure 1B depicts a step of dispensing a first quantity of potting material into the open end of a housing; Figure 1C depicts insertion of the circuit board/connector assembly of Figure 1A into the housing of Figure 1B; and Figure 1D depicts a step of dispensing a second quantity of potting material into a pocket formed at the open end of the housing.

Figure 2 is a cross-sectional view of an electronic module manufactured according to this invention.

Description of the Preferred Embodiment

The manufacturing method of the present invention is disclosed in the context of an automotive electronic module such as a Sensing and Diagnostic

Module (SDM) for deploying supplemental restraints in a severe crash event. In such an application, the enclosed circuit components 14 include acceleration-responsive sensors, and the circuit board 12 has to be securely attached to the inner periphery of the housing 18 to ensure that the sensors operate correctly. Of course, similar requirements occur in other applications as well, and the manufacturing method applies to sealed electronic modules per se, whether automotive or non-automotive.

Referring to Figure 1A, the reference numeral 10 generally designates a circuit board/connector assembly, including a printed circuit board 12 supporting a number of electronic components 14, and a connector assembly 16. The connector assembly 16 is attached to the outboard end of the circuit board 12, and the components 14 may be distributed on the circuit board 12 in any convenient manner, except for a marginal portion 12a that includes the inboard end 12b of circuit board 12. The connector assembly 16 includes a plastic base plate 16a, a plastic header box 16b, and a number of metal connector pins 16c passing through the base plate 16a. The connector assembly 16 is preferably manufactured by an insert molding process so that the material of base plate 16a seals around the connector pins 16c. The leftward extending (outboard) ends of the pins 16c are disposed within the header box 16b (as seen in the cross-sectional view of Figure 2) for attachment to a complementary electrical connector (not shown); and the rightward extending (inboard) ends of the pins 16c are bent toward the circuit board 12 for attachment thereto. Typically, the pins 16c extend through plated openings formed in the circuit board 12, and are soldered in place to both electrically and mechanically connect the circuit board 12 to the connector assembly 16.

In Figures 1B, 1C and 1D, the reference numeral 18 generally designates a housing for enclosing the circuit board/connector assembly 10. The housing 18 is preferably formed of plastic, and includes integral mounting tabs 18a for securing the completed electronic module to a support structure such as a vehicle frame element. The housing 18 is closed on all sides and one end, and is oriented so that the open end 18b is pointed upward as shown. The housing 18

is dimensioned so as to freely receive the circuit board/connector assembly 10 of Figure 1A, with the inner periphery of the housing generally conforming to the circumferential periphery of the connector assembly base plate 16a.

As shown in Figure 1B, a dispensing nozzle 22 is positioned over the open end 18b of housing 18, and first quantity of potting material 20 is dispensed into bottom of housing 18. The potting material 20 fills the interior volume of housing 18 to a level such as shown by the broken line 24. The circuit board/connector assembly 10 is then inserted into the housing 18 as illustrated in Figure 1C before the potting material 20 cures and hardens, immersing the marginal portion 12a of circuit board 12 into the potting material 20. This may be best seen in Figure 2, which depicts a completed electronic module 26. As also shown in Figure 2, the portion of the circuit board 12 on which the components 14 are mounted is not immersed in the potting material 20; this is important as it is inadvisable to coat certain electronic components with potting material.

When the circuit board/connector assembly 10 has been fully inserted into the housing 18, there is an annular pocket or cavity 28 through which the connector assembly header box 16b extends. Referring to Figures 1D and 2, the cavity 28 is defined by the connector assembly base plate 16a and header box 16b and the inner periphery of the housing 18 above the base plate 16a. At this point, the dispensing nozzle 22 is positioned over the cavity 28 as illustrated in Figure 1D, and a second quantity of potting material 30 is dispensed into the cavity 28, preferably filling the cavity volume as depicted in Figure 2.

The last step of the process is to allow undisturbed curing of the first and second quantities of potting material 20, 30 so that the potting material hardens substantially where dispensed. Referring to Figure 2, the first quantity of potting material 20 then effectively attaches the marginal portion 12a of the circuit board 12 to the inner periphery 18c of the housing 18, and the second quantity of potting material 30 forms a seal between the connector assembly 16 and the inner periphery 18c of the housing 18, environmentally sealing the module 26. The potting material 20 may be of the same formulation as the

potting material 30, or a different formulation if desired. In any case, the potting material 20, 30 may be any commercially available potting (epoxy, for example) that has an initial free-flowing state, and that chemically cures to a hardened state.

In summary, the manufacturing method of the present invention results in a reliably sealed electronic module 26 where potting material is used both to seal the housing 18 and to secure an enclosed circuit board 12 to the inner periphery 18c of housing 18. Only a small overall amount of potting material is required, which contributes to low cost and low weight of the module 26. Also, the potting material 20 only comes into contact with the marginal portion 12a of the circuit board 12, and does not come into contact with the electrical components 14 mounted elsewhere on the circuit board 12.

While the method of the present invention has been described in reference to the illustrated embodiment, it will be recognized that various modifications will occur to those skilled in the art. For example, the housing 18 may have a shape other than rectangular, and so on. Accordingly, it will be understood that manufacturing methods incorporating these and other modifications may fall within the scope of this invention, which is defined by the appended claims.